Radio frequency module for multiple frequency multiple model mobile phone

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Abstract of **CN 2550985 (Y)**

The utility model relates to a multi-frequency multi-mode radio frequency module, which is to meet the design requirements of a great variety of cell phones with different frequency bands and modes. The utility model adopts the inner system proposals of radio frequency direct modulation emission and super heterodyne medium frequency demodulation receiving, the switchover of multi-frequency and multi-mode is realized through the function of chip PD (POWERDOWN) and the combination with a SPMT switch, thus the power consumption is decreased; at the same time, the different modes in each frequency band share a direct radio frequency orthogonal modulator, a variable gain amplifier (VGA) and a orthogonal demodulator to reduce the cost.

Claim

1. a radio-frequency module that is used for multifrequency multimode cell-phone characterized in by direct radio frequency quadrature modulator, variable gain amplifier (VGA), power amplifier, receiving and dispatching duplexer and antenna, receipt front end, intermediate frequency SAW wave filter, quadrature demodulator, and phase locking frequency synthesis source and SPMT switch component, and wherein the output of radio frequency quadrature modulator is direct links with variable gain amplifier (VGA), and phase locking frequency synthesis source is direct to be connected with quadrature modulator, quadrature demodulator and receipt front end.

2. a radio-frequency module that is used for multifrequency multimode cell-phone according to claim 1 characterized in that the IF-FRE of receiver selection is controlled for 200MHz.

A radio-frequency module that is used for multifrequency multimode cell-phone

(1), technical field:

This utility model belongs to the mobile communication field, especially relates to the radio frequency circuit technique.

(2), invention background:

The wide application of multifrequency multi-mode radio frequency module is in the multifrequency multimode mobile phones design of various forms, like GSM/WCDMA dual-frenquency / bimodulus, three frequency / four moulds of GSM/WCDMA/cdma2000/CDMA IS-95, three frequency / cell-phones such as three moulds of GSM/WCDMA/TD-SCDMA.

Since 1992, the second generation digital mobile cellular telecommunication system, as GSM and CDMA IS-95 system will reach 1,300,000,000 at fast development all over the world, number of users; Using the professional service of high speed data transmission, multi-media that provides to move IMT2000 as the 3-G (Generation Three mobile communication system) of purpose and arising at the historic moment, it has including the system cdma2000 of three kinds of differences, WCDMA and TD-SCDMA.To second generation GSM and CDMAIS-95 mobile communication system still in a large amount of uses, and the cdma2000 of the third generation, WCDMA and TD-SCDMA mobile communication system are about to put into operation, the multiple frequency channel and the compatible situation of multiple pattern move communication system of appearing suddenly urgently need multifrequency multimode cell-phone from this, freely switch over between the system of multiple different systems, in order conveniently to realize global roaming function.The radio-frequency module that is used for multifrequency multimode cell-phone has become one of research focus of radio frequency technology,The solution of this respect has two kinds,First design supports the special radio frequency chip of multifrequency multimode cell-phone to organize,Multifrequency multimode cell-phone scheme to the difference must be organized by the respective special radio frequency chip of design,The advantage is with strong points, system design optimization, low power dissipation,The shortcoming is research and development expense height, has a big risk; The second adopts general radio frequency chip to integrate at the PCB board and designs the radio-frequency module of supporting multifrequency multimode cell-phone,The advantage is that the research and development expense is low, the risk is little,To the multifrequency multimode mobile phones design of difference,Through selecting the chip in a flexible way,Realize desired system scheme,The shortcoming is that system design optimization nature is poor,The consumption is high.

This utility model purpose provides one kind to adopt general radio frequency chip at the integrated radio-frequency module of supporting multifrequency multimode cell-phone that designs of PCB board, mainly solves radio-frequency module low-power consumption and low-cost problem in the mobile phones design of multifrequency multimode, realizes and advance the business application of multifrequency multimode cell-phone.

(3), disclosure of the invention:

The technical scheme of multifrequency multi-mode radio frequency module adopts the directly modulated transmission of radio frequency, the demodulation of superhet intermediate frequency to receive, and the directly modulated transmission of radio frequency is directly modulated to the addressing machine emission frequency with the information of need transmission, has saved

If bandpas filter, upconverter and driving amplifier make the addressing machine circuit succinct; And the demodulation of superhet intermediate frequency is received, is to arrive the intermediate frequency with the radio frequency signal elder generation down coversion that the receiver was received, through if bandpas filter filtering clutter, and behind VGA's automatic gain control, is separated by the quadrature demodulator and accesses the information needed, guarantees like this that the receiver has very wide receipt dynamic range and sensitivity.Simultaneously, with chip PD function, combine the SPMT switch to realize the multimode switching of multifrequency reducing the consumption.In addition, the sharing of the not common mode of each frequency channel same direct radio frequency quadrature modulator, variable gain amplifier (VGA) and quadrature demodulator are with the reduced system structure.

The broadband design is adopted in phase locking local frequency source, and the number of the frequency source of minimize different frequency is and use the SPMT switch to switch over to the receipt front end of different frequency channels.

Adoption chip PD function is switched over to mode and frequency channel and the SPMT switch switches over the realization, has simplified the circuit structure greatly, has reduced the consumption.

Multifrequency multi-mode radio frequency module block diagram is as illustrated in FIG. 1.The module mainly by direct radio frequency quadrature modulator 1, variable gain amplifier (VGA) 2,3/1 to 3/n in the power amplifier, receiving and dispatching duplexer and 4/1 to 4/n on the antenna, receive 6/1 to 6/n of front end, 7/1 to 7/n in the intermediate frequency SAW wave filter, quadrature demodulator 8, and phase locking frequency synthesis source 5 is formed with SPMT switch 9,10,11.Characterized in: 1. the output of radio frequency quadrature modulator 1 is direct links with variable gain amplifier (VGA) 2,And complicated circuit such as intermediate frequency SAW wave filter, upconverter and driving amplifier have been saved; 2., the chip that shares to the maximum extent,Like quadrature modulator 1, quadrature demodulator 8,Especially, the variable gain amplifier of launching (VGA) 2; 3., adopted the broad-band matching technique,Make the very wide frequency range of 2 covers of variable gain amplifier (VGA),And guarantee wide linear gain control limit; 4., close IF-FRE is selected to the receiver,As about 200MHz,Intermediate frequency SAW wave filter matching circuit and the SPMT switching circuit design degree of difficulty has been simplified; 5., utilize chip some PD functions certainly,The flow of combination SPMT off-on control signal,Realize the switching between the multifrequency multimode.

As illustrated in FIG. 1, the workflow of transmission part is: the direct radio frequency quadrature modulator 1 that shares is not imported from the baseband part to the data signal of common mode, after 2 enlarged promotions of variable gain amplifier (VGA), is switched over by SPMT switch 10 and selects, import the 3/1 to 3/n in the power amplifier of different frequency channels and mode requirement, receiving and dispatching duplexer and 4/1 to 4/n on the antenna through different frequency channels and bandwidth launch again.

The workflow of receiving unit is: the different frequency channels received and the radio frequency signal of mode, through duplexer and 4/1 to 4/n on the antenna separately, imports and receives 6/1 to 6/n of front end, and the if signal feed-in different frequency and the 7/1 to 7/n in the intermediate frequency SAW wave filter of bandwidth after the mixing switch over selections through SPMT switch 11 afterwards, import

In the quadrature demodulator of different mode sharings 8, amplify back output through intermediate-frequency amplification, demodulation, baseband and give the processing of baseband part.

The local oscillator signal of radio-frequency module is produced by phase locking frequency synthesis source 5, and one of them is had a lot of social connections and takes the radio frequency phase locked source to export for the quadrature modulator, and the intermediate frequency phase locked source is exported for the quadrature demodulator all the way, and broadband radio frequency phase locked source output back is all the way in addition selected to switch over output through SPMT switch 9 and is given that to receive the front end be that phase locking frequency synthesis source 5 is direct is connected with quadrature modulator 1, quadrature demodulator 8 and receipt front end 6/1-6/n.

Data signal and AFC control signal that baseband part was not only provided transmission APC, was received AGC control signal, phase-locked loop frequency synthesizer, control signal that the mode of returning out is simultaneously switched over switches over the SPMT switch to desired mode position, and utilize chip PD function with the power amplifier of other mode work with receive the front end and close.

This utility model beneficial effect is: complicated circuit such as intermediate frequency SAW wave filter, upconverter and driving amplifier have been saved in (1), simplify the transmitting circuit structure effectively, have reduced the printed circuit board (PCB) space to take, have cut down the material cost greatly, and can low, the small and exquisite cell-phone of volume of design cost.(2), the sharing of not common mode same direct radio frequency quadrature modulator, variable gain amplifier (VGA) and the quadrature demodulator of each frequency channel are with reduced system structure, reduction of cost; (3), adopted the broad-band matching technique, it is wider that variable gain amplifier (VGA) covers the frequency range; (4), the intermediate frequency SAW wave filter matching circuit and the SPMT switching circuit design degree of difficulty have been simplified.

(4), description drawings:

Fig. 1 is multifrequency multimode cell-phone radio-frequency module block diagram;

Fig. 2 is WCDMA/GSM dual-frenquency dual-mode handset radio-frequency module block diagram.

Each symbol explanation in the picture:

PD-POWER DOWN power turn-offs;

SPMT-SINGLE PORT MULTI TURN hilted broadsword is thrown more;

AGC-AUTO GAIN CONTROL automatic gain control;

But VGA-VARIABLE GAIN AMPLIFIER gain amplifier;

AFC-AUTO FREQUENCY CONTROL automatic frequency control;

APC-AUTO POWER CONTROL automatic power control;

PCB-PRINT CIRCUIT BOARD printed circuit board (PCB).

(5), detailed description of the invention:

2 detailed description embodiment: WCDMA/GSM dual-frenquency dual-mode handset radio-frequency modules in the following combination figure.

According to relevant standard, the upper and lower line frequency section of two kinds of modes is decided to be approximately:

The mobile communication mode	The frequency channel goes upward	Down frequency channel
Standard GSM900	890 to 915MHz	935 to 960MHz
Extension GSM900	880 to 915MHz	925 to 960MHz
WCDMA	1920 to 1980MHz	2110 to 2170MHz

The accurate GSM900 mode of following GSM mode index.

Adopt two phase-locked loops in the radio-frequency module, produce 1920 to 1980MHz's radio frequency local frequency source 11,890 to 915MHz radio frequency local frequency source 9,710 to 735MHz's radio frequency local frequency source 12,1520MHz/1080MHz's IF-FRE source 10 simultaneously.

The data signal and the AFC control signal of transmission APC, receipt AGC control signal, phase-locked loop frequency synthesizer are not only provided to the baseband part, return out the control signal of mode switching simultaneously, switch over the SPDT switch to desired mode position, and utilize chip PD function to close the power amplifier of other mode work.

The sendaisle: the WCDMA of baseband output or GSM's quadrature IQ signal are given the input of direct radio frequency quadrature modulator 1, WCDMA mode modulator local oscillator and are 1920MHz to 1980MHz, and the GSM mode is 890 to 915MHz.WCDMA mode during operation,1920MHz to the 1980MHz's of 1 output of modulator WCDMA radio frequency signal through sharing variable gain amplifier (VGA) 2 amplify promote after,Switch over to WCDMA power amplifier 3 by the SPDT switch,Export after WCDMA frequency channel two merit wares 5 are launched with antenna 6; The work of GSM mode is very little,890MHz to the 915MHz's of modulator output GSM radio frequency signal after sharing variable gain amplifier (VGA) 2 amplifies promotions,Switch over to GSM power amplifier 4 by the SPDT switch,Export after transmit-receive switch 7 is launched with antenna 8.

Receive path: 2110 to 2170MHz's that the antenna was received WCDMA radio frequency signal,Import to share through WCDMA frequency channel antenna 6 and duplexer 5 and receive front end 13,After enlarged, mirror image suppress band-pass filter, mixing,Export WCDMA intermediate frequency SAW bandpass filter 15,In importing sharing quadrature demodulator 16 again,Through intermediate frequency AGC amplify, after the I/Q demodulation, low-pass filtering,Output WCDMA's I, two road bed band signals of Q,Through baseband amplifier 17,Give the baseband and do the demodulation processing; 925 to 960MHz's that the antenna was received GSM radio frequency signal,Through 7 input sharing receipt front ends 13 of antenna duplexer,After enlarged, mirror image suppress band-pass filter, mixing,Export GSM intermediate frequency SAW bandpass filter 14,In importing sharing quadrature demodulator 16 again,Through intermediate frequency AGC amplify, after the I/Q demodulation, low-pass filtering,Output GSM's I, two road bed band signals of Q,Through baseband amplifier 17,Give the baseband and do the demodulation processing.

Front end 13, GSM intermediate frequency SAW bandpass filter 14, WCDMA intermediate frequency SAW bandpass filter 15, sharing quadrature demodulator 16, baseband amplifier 17 are mainly received by direct radio frequency quadrature modulator 1, variable gain amplifier (VGA) 2, WCDMA power amplifier 3, GSM power amplifier 4, WCDMA frequency channel receiving and dispatching duplexer 5 and antenna 6, GSM frequency channel transmit-receive switch 7 and antenna 8, sharing to WCDMA/GSM dual-frenquency dual-mode handset radio-frequency module, and phase locking frequency source 9,10,11,12 is formed.Its characteristic is direct and 2 hookups of variable gain amplifier (VGA) of output of radio frequency quadrature modulator 1 1.,And complicated circuit such as intermediate frequency SAW wave filter, upconverter and driving amplifier have been saved; 2., the chip that shares to the maximum extent,Like quadrature modulator 1, variable gain amplifier (VGA) 2, receive front end 13, quadrature demodulator 16, baseband amplifier 17; 3., adopted the broad-band matching technique,Make the very wide frequency range of 2 covers of variable gain amplifier (VGA),And guarantee wide linear gain control limit; 4., receive the 13 commercial chips that adopt MAXIAM company of front end,Two independent radio frequency signal inputs and if signal output have,Can directly be connected with the intermediate frequency SAW wave filter 15 and 14 of WCDMA and GSM mode,The SPDT switch has been saved; 5., utilize chip some PD functions certainly,Combine SPDT switch switching WCDMA and GSM mode power amplifier 3 and 4,Realize the switching between frequency channel and the mode.

Used general radio frequency chip and firm:

1. quadrature modulator: RF2483 RFMD company;

2.VGA:RF2378 RFMD company;

3.WCDMA power amplifier: RF2186 RFMD company;

4.GMS power amplifier: RF2173 RFMD company;

5. receipt front end: MAX2320 MAXIAM company;

6. quadrature demodulator: RF2689 RFMD company;

7. phase locked source: Si4133 Silicon Lab. company integrates;

8.WCDMA intermediate frequency SAW wave filter: TMXL112 THOMSON company;

9.GMS intermediate frequency SAW wave filter: B4846 EPCOS company.

In the actual development, suitably adjust I, Q signal biasing voltage and I, the performance of quadrature modulator is optimized to Q signal amplitude, phase place. Select the good low-noise amplifier of linear degree can reduce duplexer cost and volume, to strong receipt signal, in order to avoid the nonlinearity, should fall the low-noise amplifier short circuit, and in order to satisfy requirement linear and sensitivity simultaneously, the gain that the short circuit falls requires point-device gain control. At the composing design time, adopt 6 layers of PCB board wiring, reduced various stray radiations effectively and harassed, improved receiving and dispatching and separated

Leave, thereby guaranteed the overall index of radio-frequency module. The technical indicator:

1 WCDMA/GSM dual-frenquency in the table / double mode radio-frequency module technical indicator

The technical indicator project	The WCDMA mode	The GSM mode
The working method	CDMA, FDD	TDMA, FDD
The working frequency goes upward	1920 to 1980MHz	890 to 915MHz
Down working frequency	2110 to 2170MHz	935 to 960MHz
The duplex interval	190MHz	45MHz
The channel spacing	5MHz	200KHz
The modulation system	The QPSK modulation	The GMSK modulation
The reception sensitivity	- 110dBm	- 106dBm
Output power	21dBm	33dBm

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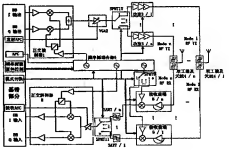
[54] 实用新型名称 一种用于多频多模手机的射频模块

[57] 摘要

多频多模射频模块是为了满足多种不同频段和模式手机设计的需求。采用射频直接调制发射、超外差中频解调接收内系统方案，以芯片的 PD(POWERDOWN)功能，结合 SPMT 开关实现多频多模的切换，降低功耗；同时，各个频段的不同模式共用同一个直接射频正交调制器、可变增益放大器(VGA)和正交解调器，以降低成本。



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1．一种用于多频多模手机的射频模块，其特征在于由直接射频正交调制器、可变增益放大器(VGA)、功率放大器、收发双工器及天线、接收前端、中频SAW滤波器、正交解调器，以及锁相频率综合源和SPMT开关组成，其中射频正交调制器的输出端直接与可变增益放大器（VGA）联接，锁相频率综合源直接与正交调制器、正交解调器及接收前端连接。

2．如权利要求1所述的一种用于多频多模手机的射频模块，其特征在于接收机选择的中频频率为200MHz左右。

一种用于多频多模手机的射频模块

（一）技术领域：

本实用新型属于移动通讯领域，尤其涉及射频电路技术。

（二）发明背景：

多频多模射频模块广泛应用于各种形式的多频多模手机设计中，如GSM/WCDMA 双频/双模、GSM/WCDMA/cdma2000/CDMA IS-95 三频/四模、GSM/WCDMA/TD-SCDMA 三频/三模等手机。

自 1992 年以来，第二代数字蜂窝移动通信系统，如 GSM 和 CDMA IS-95 系统在世界各地迅猛发展，用户数将达到 13 亿；以提供高速数据传输、多媒体业务服务为目的的第三代移动通信系统移动 IMT2000 应运而生，它有包括三种不同的体制 cdma2000、WCDMA 和 TD-SCDMA。针对第二代 GSM 和 CDMA IS-95 移动通信系统还在大量使用，而第三代的 cdma2000、WCDMA 和 TD-SCDMA 移动通信系统即将投入运行，由此突现的多种频段和多种模式移动通信系统并存的局面，迫切需要多频多模手机，在多种不同体制的系统之间自由切换，以方便实现全球漫游功能。用于多频多模手机的射频模块已经成为射频技术的研究热点之一，这方面的解决方案有两种，其一是设计支持多频多模手机的专用射频芯片组，针对不同的多频多模手机方案须设计各自的专用射频芯片组，优点是针对性强、系统设计优化、功耗低，缺点是研发费用高、风险大；其二是采用通用射频芯片在 PCB 板集成设计支持多频多模手机的射频模块，优点是研发费用低、风险小，针对不同的多频多模手机设计，通过灵活地选择芯片，实现所要求的系统方案，缺点是系统设计优化性差，功耗高。

本实用新型目的是提供一种采用通用射频芯片在 PCB 板集成设计支持多频多模手机的射频模块，主要解决多频多模手机设计中的射频模块低功耗和低成本的问题，实现并推进多频多模手机商业应用。

（三）发明内容：

多频多模射频模块的技术方案采用射频直接调制发射、超外差中频解调接收，射频直接调制发射是将需传输的信息直接调制到发信机发射频率，省去了

中频带通滤波器、上变频器及推动放大器，使得发信机电路简洁；而超外差中频解调接收，是将接收机接收的射频信号先下变频到中频，经中频带通滤波器滤除杂波，并经 VGA 的自动增益控制后，由正交解调器解调出所需信息，这样确保接收机具有很宽的接收动态范围和灵敏度。同时，以芯片 PD 功能，结合 SPMT 开关实现多频多模的切换，降低功耗。此外，各个频段的不同模式共用同一个直接射频正交调制器、可变增益放大器（VGA）和正交解调器，以简化系统结构。

锁相本振频率源采用宽带设计，尽量减少不同频率的频率源的个数，并且使用 SPMT 开关切换到不同频段的接收前端。

模式和频段切换采用芯片 PD 功能和 SPMT 开关切换实现，大大简化了电路结构、降低了功耗。

多频多模射频模块框图如图 1 所示。模块主要由直接射频正交调制器 1、可变增益放大器（VGA）2、功率放大器 3/1~3/n、收发双工器及天线 4/1~4/n、接收前端 6/1~6/n、中频 SAW 滤波器 7/1~7/n、正交解调器 8，以及锁相频率综合源 5 和 SPMT 开关 9，10，11 组成。其特征在于：①射频正交调制器 1 的输出端直接与可变增益放大器（VGA）2 联接，而省去了中频 SAW 滤波器、上变频器和推动放大器等复杂电路；②最大限度地共用芯片，如正交调制器 1、正交解调器 8，尤其是发射的可变增益放大器（VGA）2；③采用了宽带匹配技术，使可变增益放大器（VGA）2 覆盖很宽的频率范围，并保证宽的线性增益控制范围；④接收机选择相近的中频频率，如 200MHz 左右，简化了中频 SAW 滤波器匹配电路及 SPMT 开关电路设计难度；⑤利用芯片自有的 PD 功能，结合 SPMT 开关控制信号的流程，实现多频多模之间的切换。

如图1所示，发射部分的工作流程为：不同模式的数据信号从基带部分输入到共用的直接射频正交调制器1，经可变增益放大器（VGA）2放大推动后，由SPMT开关10切换选择，输入到不同频段和模式要求的功率放大器3/1~3/n，再经不同频段和带宽的收发双工器及天线4/1~4/n发射出去。

接收部分的工作流程为：接收到的不同频段和模式的射频信号，经各自双工器及天线4/1~4/n，输入到接收前端6/1~6/n，经过混频后的中频信号馈入不同频率和带宽的中频SAW滤波器7/1~7/n，随后经SPMT开关11切换选择，输入到

不同的模式共用的正交解调器8中，经中频放大、解调、基带放大后输出给基带部分处理。

射频模块的本振信号由锁相频率综合源5产生，其中一路宽带射频锁相源输出给正交调制器，一路中频锁相源输出给正交解调器，还有一路宽带射频锁相源输出后，经SPMT开关9选择切换输出给接收前端即锁相频率综合源5直接与正交调制器1、正交解调器8及接收前端6/1-6/n连接。

基带部分不仅给出发射 APC、接收 AGC 控制信号、锁相环频率合成器的数据信号以及 AFC 控制信号，同时还给出模式切换的控制信号，将 SPMT 开关切换到所要求的模式位置，并利用芯片 PD 功能将其他模式工作的功率放大器和接收前端关闭。

本实用新型有益效果为：（1）省去了中频 SAW 滤波器、上变频器和推动放大器等复杂电路，有效地简化发射电路结构，减小了印刷电路板空间占用，大大削减了材料成本，可以设计成本低、体积小巧的手机。（2）各个频段的不同模式共用同一个直接射频正交调制器、可变增益放大器（VGA）和正交解调器，以简化系统结构、降低成本；（3）采用了宽带匹配技术，可变增益放大器（VGA）覆盖频率范围更广；（4）简化了中频 SAW 滤波器匹配电路及 SPMT 开关电路设计难度。

（四）附图说明：

图 1 为多频多模手机射频模块框图；

图 2 为 WCDMA/GSM 双频双模手机射频模块框图。

图中各符号说明：

PD—POWER DOWN 电源关断；

SPMT—SINGLE PORT MULTI TURN 单刀多掷；

AGC—AUTO GAIN CONTROL 自动增益控制；

VGA—VARIABLE GAIN AMPLIFIER 可增益放大器；

AFC—AUTO FREQUENCY CONTROL 自动频率控制；

APC—AUTO POWER CONTROL 自动功率控制；

PCB—PRINT CIRCUIT BOARD 印刷电路板。

（五）具体实施方式：

以下结合附图2详述实施例：WCDMA / GSM 双频双模手机射频模块。

根据相关标准，两种模式的上、下行频段约定为：

移动通信模式	上行频段	下行频段
标准GSM900	890~915MHz	935~960MHz
扩展GSM900	880~915MHz	925~960MHz
WCDMA	1920~1980MHz	2110~2170MHz

以下GSM模式指标准GSM900模式。

射频模块中采用两个双锁相环，同时产生1920~1980MHz的射频本振频率源11、890~915MHz射频本振频率源9、710~735MHz的射频本振频率源12、1520MHz/1080MHz的中频频率源10。

基带部分不仅给出发射APC、接收AGC控制信号、锁相环频率合成器的数据信号以及AFC控制信号，同时还给出模式切换的控制信号，将SPDT开关切换到所要求的模式位置，并利用芯片PD功能将其他模式工作的功率放大器关闭。

发送通道：基带输出的WCDMA或GSM的正交IQ信号送给直接射频正交调制器1，WCDMA模式调制器本振输入为1920MHz~1980MHz，GSM模式为890~915MHz。WCDMA模式工作时，调制器1输出的1920MHz~1980MHz 的WCDMA射频信号经共用可变增益放大器（VGA）2放大推动后，由SPDT开关切换到WCDMA功率放大器3，输出后经WCDMA频段双功器5和天线6发射出去；GSM模式工作时，调制器输出的890MHz~915MHz的GSM射频信号经共用可变增益放大器（VGA）2放大推动后，由SPDT开关切换到GSM功率放大器4，输出后经收发开关7和天线8发射出去。

接收通道：天线接收的2110～2170MHz 的 WCDMA 射频信号，通过 WCDMA 频段天线 6 和双工器 5 输入到共用接收前端 13，经放大、镜象抑制带通滤波、混频后，输出到 WCDMA 中频 SAW 带通滤波器 15，再输入到共用正交解调器 16 中，经中频 AGC 放大、I/Q 解调、低通滤波后，输出 WCDMA 的 I、Q 二路基带信号，经基带放大器 17，送给基带作解调处理；天线接收的 925～960MHz 的 GSM 射频信号，通过天线收发开关 7 输入共用接收前端 13，经放大、镜象抑制带通滤波、混频后，输出到 GSM 中频 SAW 带通滤波器 14，再输入到共用正交解调器 16 中，经中频 AGC 放大、I/Q 解调、低通滤波后，输出 GSM 的 I、Q 二路基带信号，经基带放大器 17，送给基带作解调处理。

WCDMA /GSM 双频双模手机射频模块主要由直接射频正交调制器 1、可变增益放大器（VGA）2、WCDMA 功率放大器 3、GSM 功率放大器 4、WCDMA 频段收发双工器 5 和天线 6、GSM 频段收发开关 7 和天线 8、共用接收前端 13、GSM 中频 SAW 带通滤波器 14、WCDMA 中频 SAW 带通滤波器 15、共用正交解调器 16、基带放大器 17，以及锁相频率源 9，10，11，12 组成。其特征①射频正交调制器 1 的输出端直接与可变增益放大器（VGA）2 联接，而省去了中频 SAW 滤波器、上变频器和推动放大器等复杂电路；②最大限度地共用芯片，如正交调制器 1、可变增益放大器（VGA）2、接收前端 13、正交解调器 16、基带放大器 17；③采用了宽带匹配技术，使可变增益放大器（VGA）2 覆盖很宽的频率范围，并保证宽的线性增益控制范围；④接收前端 13 采用 MAXIAM 公司的商用芯片，具有两个独立的射频信号输入端和中频信号输出端，可以直接与 WCDMA 和 GSM 模式的中频 SAW 滤波器 15 和 14 连接，省去了 SPDT 开关；⑤利用芯片自有的 PD 功能，结合 SPDT 开关切换 WCDMA 和 GSM 模式功放 3 和 4，实现频段和模式之间的切换。

所用通用射频芯片及厂商：

1．正交调制器：RF2483	RFMD 公司；
2．VGA：RF2378	RFMD 公司；
3．WCDMA 功放：RF2186	RFMD 公司；
4．GMS 功放：RF2173	RFMD 公司；
5．接收前端：MAX2320	MAXIAM 公司；
6．正交解调器：RF2689	RFMD 公司；
7．集成锁相源：Si4133	Silicon Lab. 公司；
8．WCDMA 中频 SAW 滤波器：TMX L112	THOMSON 公司；
9．GMS 中频 SAW 滤波器：B4846	EPCOS 公司。

实际研制中，适当调节I，Q信号偏置电压和I，Q信号幅度、相位来优化正交调制器的性能。选择线性度好的低噪声放大器可以降低双工器成本和体积，对于强的接收信号，为了避免非线性，应将低噪声放大器短接掉，而为了同时满足线性和灵敏度的要求，短接掉的增益要求非常精确的增益控制。在排版设计时，采用6层PCB板布线，有效地降低了各种杂散辐射和窜扰，提高了收发隔

离,从而保证了射频模块的总体指标。

技术指标:

表 1 WCDMA/GSM 双频/双模式射频模块技术指标

技术指标项目	WCDMA 模式	GSM 模式
工作方式	CDMA，FDD	TDMA，FDD
上行工作频率	1920~1980MHz	890~915MHz
下行工作频率	2110~2170MHz	935~960MHz
双工间隔	190MHz	45MHz
信道间隔	5MHz	200KHz
调制方式	QPSK 调制	GMSK 调制
接收灵敏度	-110dBm	-106dBm
输出功率	21dBm	33dBm

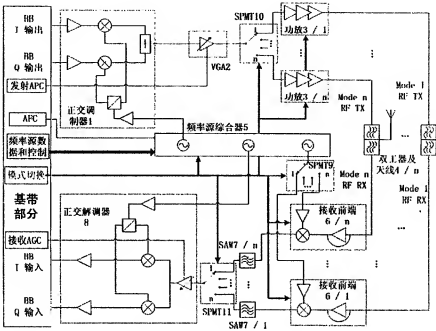
BB
I 输出
BB
Q 输出
发射APC
AFC
频率源数据和控制
模式切换
基带部分
接收AGC
BB
I 输入
BB
Q 输入
正交调制器1
VGA2
SPMT10
功放3 / 1
功放3 / n
Mode n
RF TX
Mode 1
RF TX
频率源综合器5
双工器及天线4 / n
双工器及天线4 / 1
SPMT9
Mode n
RF RX
Mode 1
RF RX
正交解调器8
接收前端6 / n
SAW7 / n
接收前端6 / 1
SPMT11
SAW7 / 1

图 1

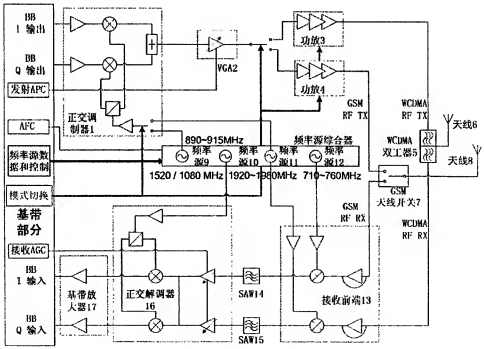
BB
I 输出
BB
Q 输出
发射APC
AFC
频率源数据和控制
模式切换
基带部分
接收AGC
BB
I 输入
BB
Q 输入
正交调制器1
VGA2
功放3
功放4
GSM
RF TX
WCDMA
RF TX
天线6
WCDMA双工器5
天线8
890~915MHz
频率源9
频率源10
频率源11
频率源12
频率源综合器
1520 / 1060 MHz
1920~1980MHz
710~760MHz
GSM
天线开关7
GSM
RF RX
WCDMA
RF RX
基带放大器17
正交解调器16
SAW14
接收前端13
SAW15

图 2